General Information	MASTER DEGREE IN BIOTECHNOLOGIES
Title of the subject	Biomarkers
Degree Course (class)	Industrial and Environmental Biotechnology (LM-8)
ECTS credits	3 CFU
Compulsory attendance	yes
Language	italian
Academic year	2020/2021

Subject Teacher	
Name and Surname	Serena Milano
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Place and time of reception	Nuovo Palazzo Biologia, 4 th floor room 2, Monday 11.30-13.30

ECTS credits details	Discipline sector (SSD)	Area
	BIO09	---

Study plan schedule	Year of study plan	Semester
	I°	I°

Time management	Lessons	Laboratory	Exercises	Total
CFU	2	1		3
Total hours	50	25		75
In-class study hours	16	12		28
Out-of-class study hours	34	13		47

Syllabus	
Prerequisites / Requirements	

Basic knowledge of General Physiology

Expected learning outcomes (according to Dublin descriptors)	
Knowledge and understanding	*Acquisition of advanced knowledge in the field of animal physiology about the exposure to xenobiotics; Understanding of the complex mechanisms of adaptation to different environmental conditions*
Applying knowledge	*Ability to use biotechnological methodologies to identify specific biomarkers*
Making informed judgments and choices	*Ability to identify and propose general and specific biomarkers. Ability to critically analyze the results obtained and to propose alternative approaches to validate the reliability of the results obtained*
Communicating knowledge	*Students will have the adequate oral communication tools to critically discuss topics covered in this course; they will also be able to describe the biological causes underlying diseases associated with exposure to xenobiotics.*
Capacities to continue learning	*The students of the course will develop learning skills and deepening of other skills by consulting bibliographic material. They will be able to deepen the concepts related to exposure to xenobiotics and therefore propose appropriate biomarkers.*

Study Program	
Content	**Physiological responses of organisms to the environment** Adaptations to the marine environment High altitude adaptations Adaptations in microgravity conditions: Principles of renal physiology, examples of biomarkers **Introduction to Ecotoxicology** The environmental crisis Natural and synthetic contaminants Prevention of environmental contamination The "tools" of ecotoxicology - predictive tools **Diagnostic and prognostic tools** The bioindication Primary targets of pollutants Biomarkers definition **Biomarkers for plant organisms** Lichens and determination of the Atmospheric Purity Index **Biomarkers and biomonitoring** Biomarkers: advantages and limitations Detoxification mechanisms: first and second phase enzymes **Strategies for the use of biomarkers** Three example cases Biomarkers of exposure and effect Strategy for using biomarkers in a biomonitoring program Biomarkers and particulate matter: principles of respiratory physiology **The main methodologies** Classification Alterations of DNA Protein responses Metabolic products Alterations of the immune system Histopathological changes Physiological and non-specific biomarkers Behavioral biomarkers **Use of biomarkers in "environmental management" programs** Biomarkers in the ecotoxicological monitoring of areas with industrial activities **The evolution of Biomarkers: the non-destructive approach** From the environment at risk to the species at risk Strategies for the use of non-destructive biomarkers Development and validation of non-destructive methodologies Non-destructive biomarkers in the study of marine mammals Biomarkers of pesticides Heavy metals and health porphyrins **Biomarkers for estrogenic compounds** Estrogenic compounds EDCS contamination in the Mediterranean environment
Bibliography and textbooks	Biomarkers in Medicine, Drug Discovery, and Environmental Health. Edited by Vishal S Vaidya and Joseph V. Bonventre
Notes to textbooks	

Teaching methods	Lessons carried out with projection of diagrams and tables provided to the teacher together with the reference text and scientific publications. At the beginning of each lesson, the topics that will be covered are discussed collectively in order to understand the basic knowledge already held by the students and fill any gaps and doubts.
Assessment methods (oral, written, ongoing assessment)	Oral assessment
Evaluation criteria (describe criteria for each of the above expected outcomes)	During the oral interview, students are expected to be able to critically discuss, with a scientific method and with technical language, the environmental and biota crisis, proposing the application of ecotoxicology tools and the use of biomarkers also in relation to impact of the environment on human health.
Further information	